Patent claims

1. A device for thermally treating at least one optical waveguide,

- having a radiation source (3) for thermally treating at least one optical waveguide (1, 2),

- having a first optical system (10) for directing a beam (8), emitted by the radiation source, onto the optical waveguide (1, 2) from a first side, wherein

- the first optical system (10) generates a beam profile (4) of the beam whose extent in the transverse direction with respect to a longitudinal axis (LA) of the optical waveguide corresponds to at least twice a diameter (df) of the optical waveguide,

- the optical waveguide (1, 2) is positioned completely outside a center axis (A) of the beam profile (4) in the transverse direction with respect to the longitudinal axis (LA) of the optical waveguide in the focusing area of the beam inside which the radiation strikes the optical waveguide,

- having a second optical system (20, 30, 40) which is positioned behind the optical waveguide (1, 2) in the direction of a beam path of the beam and which reflects radiation (5) which is transmitted past the side of the optical waveguide and directs it onto the optical waveguide (1, 2) from a second side.

2. The device as claimed in claim 1, characterized in that the second optical system (20, 30, 40) is configured in such a way that it images the emitted beam profile (4) in a plane (xz) parallel to a longitudinal axis of the optical waveguide in a different way than in a plane (yz) extending transversely with respect to the longitudinal axis of the optical waveguide.

3. The device as claimed in claim 2, characterized in that the second optical system (20, 30, 40) is configured in such a way that it images the beam profile (4) in a noninverted fashion in the plane (xz) parallel to the longitudinal axis of the optical waveguide and images it in an inverted fashion in the plane (yz) extending transversely with respect to the longitudinal axis of the optical waveguide, in particular in each case with an approximate ratio of 1:1.

4. The device as claimed in one of claims 1 to 3, characterized in that the second optical system (20) comprises a plane mirror (22) and an aspherical lens (21) or a respective combination of optical elements which acts in an analogous fashion, wherein the lens is arranged between the optical waveguide and the plane mirror.

5. The device as claimed in claim 4, characterized in that the aspherical lens (21) has two different focal lengths (fx, fy) in the plane (xz) parallel to the longitudinal axis of the optical waveguide and in the plane (yz) extending transversely with respect to said longitudinal axis.

6. The device as claimed in claim 4 or 5, characterized in that in the plane (yz) extending transversely with respect to the longitudinal axis of the optical waveguide a focal length (fy) of the aspherical lens (21) is essentially equal to the distance between the lens and the optical waveguide.

7. The device as claimed in one of claims 1 to 3, characterized in that

- the second optical system (30) comprises a plane

mirror (33) and two cylindrical lenses (31, 32) or a respective combination of optical elements which acts in an analogous fashion,

- the lenses are arranged between the optical waveguide and the plane mirror,

- a first lens of the lenses (32) does not have any refractive power in a plane (xz) parallel to a longitudinal axis of the optical waveguide, and a second lens of the lenses (31) does not have any refractive force in a plane (yz) extending transversely with respect to said longitudinal axis.

8. The device as claimed in one of claims 1 to 3, characterized in that

- the second optical system (50) comprises a plane mirror (53), a spherical lens (51) and a cylindrical lens (52) or a respective combination of optical elements which acts in an analogous fashion,

- the lenses are arranged between the optical waveguide (1, 2) and the plane mirror,

- the spherical lens (51) has the same refractive power (f51x, f51y) in a plane (xz) parallel to a longitudinal axis of the optical waveguide and in a plane (yz) extending transversely with respect to said longitudinal axis, and the cylindrical lens does not have any refractive power in one of the planes (yz).

9. The device as claimed in one of claims 7 or 8, characterized in that a focal length (f32, f51y) of one of the lenses (32, 51) is essentially equal to the distance between this lens and the optical waveguides in the plane (yz) extending transversely with respect to the longitudinal axis of the optical waveguide.

10. The device as claimed in one of claims 1 to 3,

characterized in that

- the second optical system (40) comprises a cylindrical mirror (42) which is concave in a plane (yz) extending transversely with respect to a longitudinal axis of the optical waveguide, and a cylindrical lens (41), or a respective combination of optical elements which acts in an analogous fashion,
- the cylindrical lens is arranged between the optical waveguide and the cylindrical mirror,
- the cylindrical lens (41) does not have any refractive power in the plane (yz) extending transversely with respect to a longitudinal axis of the optical waveguide, and the cylindrical mirror (42) is planar in a plane (xz) parallel to the longitudinal axis of the optical waveguide.

11. The device as claimed in claim 10, characterized in that in the plane (yz) extending transversely with respect to the longitudinal axis of the optical waveguide a focal length (f42) of the cylindrical mirror (42) is essentially half the distance between the cylindrical mirror and the optical waveguide.

12. The device as claimed in one of claims 1 to 11, characterized in that the device is configured in such a way that a plurality of optical waveguides (101 to 103) which are arranged one next to the other can be treated thermally in parallel, in particular can be welded in parallel with optical waveguides (201 to 203) lying correspondingly opposite.

13. The device as claimed in claim 12, characterized in that

- a distance (ab) between two optical waveguides (101, 102; 201, 202) lying one next to the other corresponds to

at least a diameter (df) of the optical waveguide,

- the extent (Wy) of the beam profile (4) extending transversely with respect to a longitudinal axis of one of the optical waveguides in the focusing area corresponds to at least the sum of the diameters (df) of all the optical waveguides (101 to 103; 201 to 203) lying one next to the other and of the intermediate distances (ab), wherein the beam profile (4) extends over an outermost optical waveguide (103, 203) by a length of the order of magnitude of at least one diameter (df) of one of the optical waveguides.

14. The device as claimed in claim 12, characterized in that

- the optical waveguides (101 to 103; 201 to 203) lying one next to the other are arranged on the opposite side of a center axis (A) of the beam profile (4),
- the extent (Wy) of the beam profile extending transversely with respect to a longitudinal axis of one of the optical waveguides in the focusing area corresponds to at least twice the sum of the diameters of all the optical waveguides lying one next to the other and of the intermediate distances.

15. The device as claimed in one of claims 1 to 14, characterized in that in a plane (yz) extending transversely with respect to a longitudinal axis of the optical waveguide an angle (α) is provided between an optical axis of the first optical system (OA1) and an optical axis of the second optical system (OA2).

16. The device as claimed in one of claims 1 to 15, characterized in that the first optical system (10) has a diffractively acting optical element (11).

17. The device as claimed in one of claims 1 to 16, characterized in that

- the first optical system (10) has an optical component (11) for directing the beam (8) onto the optical waveguide (1, 2) to be spliced,
- the device has a drive device (7) for the optical component (11), wherein the optical component can be moved with the aid of the drive device in such a way that a position of the focusing area of the beam can be shifted in its longitudinal direction (70), in particular can be moved periodically.